

Evaluation of the Efficacy of Simulation Games in Traffic Safety Education of Kindergarten Children

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Abstract: Using a simulation game designed to teach children to obey certain traffic safety rules, an experimental study was conducted with 136 five-year-old children in four Quebec schools. Within each classroom, subjects were randomly divided into four groups: three intervention groups and one control group. Each of the experimental groups was subjected to a different intervention with

outcome measured using three instruments related to attitudes, behavior, and transfer of learning of pedestrian traffic safety. Results suggest that simulation games including role-playing/group dynamics and modeling/training can change attitudes and modify behavior in the area of pedestrian traffic safety in children of this age. (*Am J Public Health* 1989; 79:307-309.)

Introduction

In Quebec, a Canadian province with 6 million inhabitants, the 1984 pedestrian injury rate in 5- to 9-year old children was 162.4/100,000 as compared to 67.1 for the population as a whole.¹ The prevention of such accidents involves legislation, engineering, education, or a combination of these. One possible way of preventing accidents is to teach children to obey certain rules of safety. This study evaluates a simulation game as an effective educational strategy in reaching this goal.

A "simulation game" is a simplified and dynamic model of a real or hypothetical system where players, following a set of rules, compete or cooperate in order to win. We used a simulation game, developed by la Régie de l'Assurance automobile du Québec (Automobile Insurance Board) and the Ministère de l'Éducation, and a proposed component of Quebec's preschool program.

Research on attitude and behavior modification suggests that role-playing group dynamics and model-training are effective means of triggering change in attitudes or behaviors and that they can be used effectively in simulation games. Role-playing group dynamics is more important in attitude change,²⁻⁷ while modeling-training appears to have a stronger impact on behavior.⁸⁻¹² Simulation is a good strategy for effecting changes of attitudes or behaviors in psychosocial situations and produces transfer of learning.¹³⁻¹⁶ Transfer of learning is defined as: "The extent to which the learning of an instructional event contributes or detracts from subsequent problem solving or learning of subsequent instructional events."¹⁷ For example, knowledge in one sport may be transferable to another sport, typewriting skills may be transferred to a computer keyboard, etc.

The objective of this study was to determine the effect of certain elements within a simulation—namely role playing/group dynamics, and behavior modeling/training—on the attitudes and behaviors and transfer of learning of five-year-old pedestrians with respect to traffic safety rules.

Methods

We used an experimental scheme based on the post-test-only control group design because a pre-test might have

provided participants with knowledge which would influence their reaction to the instrument.

The four schools participating in this study are representative of the schools in Montreal, a principal city in the province of Quebec. Within each school, two kindergarten classes composed of five-year-old children were selected. This age group was chosen because the traffic safety program is designed for kindergarten children. Within each class, children were randomly allocated to each of four groups: three intervention and one control.

The experiment consisted of two three-hour sessions. The first involved the presentation of the simulation games and the administration of attitude and behavior tests. The second session, conducted 10 days later, included only the administration of the transfer of learning test.

Intervention

We used three simulation games with the same learning content: traffic safety for the pedestrian. Each of the three experimental interventions included different elements within the same basic simulation game structure. Basically, the game simulates a part of a town complete with streets and sidewalks (dimensions: 1.22m × 2.44m). Five-year-old pedestrians "walk through" the miniature streets using finger puppets drawn on the backs of their hands.* The three simulation games are:

- **ATTITUDE:** This simulation game includes role-playing and group dynamics elements and is intended to primarily affect attitude change. Personal (verbal and behavioral) interactions and a loose scenario centered around a specific situation constitute the unique features of this simulation game.
- **BEHAVIOR:** This simulation game includes modeling and training elements and is intended to change behavior. Observation of a model, behavioral imitation, and feedback constitute the unique features of this simulation game.
- **ATTITUDE AND BEHAVIOR:** This simulation game includes role-playing, group dynamics, modeling and training elements and is intended to alter both attitude and behavior. The features from the other two simulation games constitute the simulation game.

Measurements

Three measurement instruments were used.* The instruments were simple since the experiment involved five-year-olds.

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*More details on the simulation game and measurement tests are available from the authors.

Attitude measurements were based on methods developed by Gochman.¹⁸ Specifically designed for children, they measure the behavioral component of attitudes, i.e., the individual's predisposition to act when faced with the object of an attitude. This predisposition is determined by the child's perception of pedestrian vulnerability to traffic accidents, and the child's perception of the degree of danger that traffic in general presents to the pedestrian. Photographs are used to identify health risks. The children's perception of risk (health dimension) and their recommendations to avoid risk (prevention dimension) are measured. Ten photographs, validated by a jury of three researchers and tested in another group of children, were used to measure the perception of risk.

Behavior measurements were based on methods developed by Whalen and Rolf.¹⁹ Children use images to show how they would act in a given situation. The measurement instrument is composed of a picture of a road, a series of questions, and stickers to be used in answering the questions.

Transfer of learning was measured using the methods developed by Haynes.²⁰ The transfer of learning was measured by observing children's reaction to a quasi-real life model of traffic risks set-up in the gymnasium. Only the lateral transfer of learning, which is defined as any facilitation of learning resulting from possession of previous knowledge in a related field, was studied. A trained observer notes the presence or absence of a predetermined selected set of behaviors using a scoring sheet specifically designed for the behavior being observed.

Analysis

The reliability of each measurement instrument was evaluated using Chronbach's alpha. Pearson's correlation coefficient was used to associate the two different dimensions of the attitude scale, as well as to verify that attitude, behavior and transfer of learning were not related.

The four intervention groups were compared, for each of attitude, behavior, and transfer of learning, using a three-way analysis of variance model (main factor: intervention; co-factors: school, sex). Since school was considered a random factor, a mixed model was used. Interactions and co-factors were tested and dropped from the final analysis if deemed insignificant. Multiple comparisons of confidence intervals were obtained using Tukey's method.

Results

The attitude measure had a range of 0–3. Each of its two dimensions, health and prevention, had a reliability coefficient of $\alpha = 0.89$ indicating good reliability. These dimensions were highly associated (Pearson correlation coefficient, $r = 0.61$), suggesting that they constitute two aspects of the same construct. The reliability coefficient for the global score of the behavior test (range: 0 to 5) is $\alpha = 0.41$ (the small number of items (5) in this test substantially affects the reliability coefficient). The reliability coefficient for the transfer of learning test (range: 0 to 31) is $\alpha = 0.85$.

Little association was found between the two dimensions of attitude and the other study variables (behavior and transfer of learning) (correlation of health dimension of attitude and behavior, $r = 0.20$; prevention dimension of attitude and behavior, $r = 0.23$, health dimension of attitude and transfer of learning, $r = 0.30$; and prevention dimension of attitude and transfer of learning, $r = 0.26$).

With respect to the primary hypotheses under study, the statistical assessment is made separately for each of the three

TABLE 1—Summary Statistics of Attitude, Behavior and Transfer Scores by Intervention Group

Variables	Intervention			
	Control	Attitude Simulation Game	Behavior Simulation Game	Attitude/Behavior Simulation Game
ATTITUDE (range 0–3)				
Sample size	33	35	33	34
Mean \pm SD	1.3 \pm 0.7	1.9 \pm 0.7	1.8 \pm 0.6	2.0 \pm 0.7
BEHAVIOR (range 0–5)				
Sample size	34	35	33	34
Mean \pm SD	4.0 \pm 1.1	4.9 \pm 0.2	4.3 \pm 0.8	4.5 \pm 0.7
TRANSFER (range 0–31)				
Sample size	30	33	32	33
Mean \pm SD	7.9 \pm 3.7	8.7 \pm 3.1	10.4 \pm 2.1	10.1 \pm 2.3

NOTES: Attitude simulation game = simulation game including role-playing/group dynamics.

Behavior simulation game = simulation game including modeling/training.

Attitude/behavior simulation game = simulation game including role-playing/group dynamics, and modeling/training.

Control = no intervention.

components of outcome. In each case, sex was not significant and was removed from the analysis. In addition, the interaction between the intervention and the school factors was negligible and therefore removed from the analysis.

Attitude

Table 1 indicates that the means of the attitude test are similar between the intervention groups but quite different from those of the control group. Table 2 shows a clear difference between each of the three intervention groups and the control group on the attitude test. The group which used the simulation game involving role-playing/group dynamics, and modeling/training performed only slightly better than the two other intervention groups.

Behavior

The control group mean is lower than the three intervention group means. The means of groups using the simulation game that included attitude triggering elements (attitude and behavior simulation and attitude simulation) are

TABLE 2—Pairwise Mean Differences of Attitude, Behavior and Transfer Scores among Interventions for Pre-selected Contrasts

Variables	Difference Between Mean Scores	95% Confidence Interval
ATTITUDE		
Attitude simulation game vs control	0.60	0.13, 1.07
Attitude/behavior simulation game vs control	0.72	0.26, 1.21
Behavior simulation game vs control	0.52	0.05, 1.00
BEHAVIOR		
Behavior simulation game vs control	0.33	-0.57, 1.24
Attitude/behavior simulation game vs control	0.50	-0.40, 1.40
Attitude simulation game vs control	0.94	0.05, 1.84
TRANSFER		
Attitude simulation game vs control	0.83	-1.83, 3.48
Behavior simulation game vs control	2.48	-0.20, 5.15
Attitude/behavior simulation game vs control	2.22	-0.44, 4.88

NOTES: Attitude simulation game = simulation game including role playing/group dynamics.

Behavior simulation game = simulation game including modeling/training.

Attitude/behavior simulation game = simulation game including role playing/group dynamics, and modeling/training.

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superior to the means of the groups exposed to behavior triggering elements (Table 1). In addition, there is a significant difference in performance between the group having used the game containing attitude triggering elements and the control group (Table 2).

Transfer of Learning

The three intervention groups obtained a higher mean than the control group on the transfer of learning test (Table 1). However, as shown in Table 2, the confidence intervals of the differences are wide. The group that participated in the simulation game containing behavior triggering elements (modeling and training) scored slightly higher than groups exposed to simulation games containing attitude triggering elements.

Discussion

All three intervention groups did better than the control group on all three tests (attitude, behavior, and transfer of learning). More specifically, the findings on attitude confirm empirical research related to attitude modification (theories of reinforcement,²⁻⁴ group dynamics,^{8,9} dissonance,^{6,7} and inoculation.⁵ However, contrary to indications from empirical research on attitude modification, the behavior triggering elements (modeling/training) were found to be as effective as the attitude triggering elements since exposure to any of the three simulation games resulted in good traffic safety attitude.

Use of behavior triggering elements in a simulation game appeared to motivate cautious behavior (Table 1). This finding supports those of Bandura^{10,11} as well as those of Parcel and Baranowski¹² which indicate that the presence of behavior triggering elements is sufficient to modify behavior. Attitude triggering elements (role-playing/group dynamics) were more effective in motivating cautious behavior than behavior triggering elements themselves (Table 2). The main difference noted is between the subjects using games containing essentially attitude triggering elements and the control group. These results coincide with the studies of Insko,²¹ Zimbardo and Ebbesen²² which indicate that the presence of attitude triggering elements is necessary and sufficient to modify behavior.

Finally, review of the literature on simulation games¹³⁻¹⁶ suggests that they are inherently conducive to transfer of learning because they give learners a chance to test their knowledge and skill in an environment similar to reality. Although our findings support those of empirical research (all experimental groups scoring higher than the control group on transfer of learning), our results apply only to five-year-old children and to a simulation game on traffic safety situations. Therefore, they should not be generalized to other populations or to triggering elements other than those contained in the simulation games studied.

In summary, although, our findings do not allow us to conclude that the simulation games will transfer these good traffic safety habits to a real pedestrian situation, we can state that simulation games using triggering elements may serve as an effective educational strategy in modifying attitudes and behavior concerning traffic safety.

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